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GEOLOGICAL SURVEY OF CANADA.

ALFRED R. C. SELWYN, F.R.S., F.G.S., DIRECTOR.

REPORT

ON THE

GEOLOGY OF SOUTHERN NEW BRUNSWICK,

EMBRACING THE COUNTIES OF

CHARLOTTE, SUNBURY, QUEENS, KINGS, ST. JOHN
AND ALBERT,

1878-79

BY

PROF. L. W. BAILEY, M.A., PH. D., G. F. MATTHEW, M.A.,
AND R. W. ELLS, M.A.



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Montreal :

DAWSON BROTHERS,

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TO ALFRED R. C. SELWYN, F.R.S., F.G.S.,

Director of the Geological Survey of Canada.

SIR,—The geological maps accompanying this report include an area of about 6,000 square miles, surveyed by us in southern New Brunswick up to 1878, assisted in 1877 and 1878 by Mr. Wallace Broad, B.A., and in 1877 by Mr. Frank Adams, B. Ap. Sc. Detailed reports on various portions of the area have already been published from time to time in the annual Reports of Progress, and the present report may be regarded as a *resumé* of these, with a general statement of the results of the work to date, especially in relation to the geological structure of the region. The difficulties presented over a large part of the area, from the wooded and unsettled character of the country, have rendered the working out of the detailed structure in many places almost an impossibility, and the authors wish it to be understood, that, while they believe the maps as now presented are in the main correct as to general features, some portions may be found, upon future and more detailed examination, to require amendment. Especially does this apply to the Silurian belt in western and northern Charlotte and its extension east into Queens and Kings, where lack of roads and good exposures, together with an entire absence of fossils, have rendered the assigning of this group to any definite horizon a very difficult matter; and for the present, although within the area there are rocks which possess, lithologically, many characters in common with the recognized pre-Cambrian as well as others of Silurian aspect, it has been thought best to assign them provisionally to the Cambro-Silurian as most in accordance with their apparent stratigraphical position. The outlines of the different formations have been carefully traced and their stratigraphical relations in most cases clearly made out. In addition to the geological, a large amount of necessary topographical work has been done. Surveys of roads have been made by odometer, chain and pacing throughout the whole of the counties of Sunbury, Queens, Kings, St. John and Albert, with portions also of Charlotte and Westmoreland, as well as many streams and coast sections. In addition to the working out of the general geology, special examinations have been made of the Grand Lake coal field in 1872-73; of the Albert and Beliveau mining areas (Albert shales) in 1876; of the copper mines

along the southern coast in 1877, and of the anthracite mine at Lepreau in 1878. In constructing the maps, the St. John River and the coast lines have been laid down from the Admiralty chart corrected from the United States Coast Survey; the parish and county lines, with a large portion of the streams and lakes, are from the most recent data in the Crown Lands Department at Fredericton; the railways are taken from accredited plans, while the roads have been surveyed principally by ourselves.

We are, sir,

Your obedient servants,

L. W. BAILEY,
G. F. MATTHEW,
R. W. ELLS.

MONTREAL, 1st May, 1880.

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The geological formations described in this report may be stated thus:

- I. Pre-Cambrian.
- II. Cambrian.
- III. Cambro-Silurian.
- IV. Silurian. (Upper Silurian of previous reports.)
- V. Devonian.
- VI. Lower Carboniferous.
- VII. Middle Carboniferous.
- VIII. Triassic.

I. PRE-CAMBRIAN.

The rocks comprised under this heading include the Laurentian of 1870-71 and the three former divisions of the Huronian, Coastal, Coldbrook and Kingston; but for the purpose of more fully illustrating the report of 1876-71, the portion then described as Laurentian is indicated by a different color on the map. The results of the subsequent examinations of the rocks of this group, principally in 1876-77-78, when the extent and stratigraphical relations of the various members were carefully studied and defined, have been stated in the report of 1877-78. The different divisions were then found to be in ascending order.

Previous
exploration of
these rocks.

1. Basal or probable Laurentian rocks, comprising syenite, gneiss

Subdivisions 2, and felsite, the former often chloritic or talcose, and described in former reports as protogine.

2. An upper portion comprising also syenite and gneiss, with quartzite, felsite and limestone, mica and felsite schists and black graphitic slates. These two divisions form what has in earlier reports been regarded as constituting the Laurentian area of the southern portion of the province.

3. Red, grey and blackish petrosilex and felsite, with breccia conglomerates, diorites, amygdaloidal ash rocks and felspathic conglomerates, with grey felspathic sandstones, constituting the Coldbrook division of the Huronian of previous reports.

4. Chloritic, felspathic and talcose schist, often a schistose conglomerate, interstratified with beds of purple ash rock and amygdaloid, and purple conglomerate and clay slate, with pale grey and pyritous, rusty-weathering felsite and felspathic quartzite.

These constitute the Coastal division of the Huronian of former reports.

5. Reddish and grey felsite, often hard and flinty, felspathic and chloritic schist, with diorite, hornblende schist and granitoid and gneissic rocks, with heavy beds of slate conglomerate and felsite conglomerate and clay slate in the upper portion.

These constitute the Kingston division of the Huronian of former reports.

Division 2.

Of the relations of Division 2 of the above series (mica schist, limestone and fine gneiss) to the main body of coarse syenite and syenitic gneiss (Division 1), nothing further is known than is contained in the report of 1870-71, wherein they are described as the "upper series of the Laurentian area." The greatly broken and disturbed character of this supposed "upper" series, the obscure stratification of much of the underlying group, together with the frequent occurrence of intrusive masses, combine to make the determination of its position difficult. There can, however, be no question that the bulk of the calcareous and silicious strata met with in this area are more recent than the coarse granitoid rocks with which they are associated, while both are at many points seen to pass beneath the Cambrian or Primordial Silurian. Their principal mass forms a long, irregularly lenticular belt extending from the vicinity of South Bay on the west side of the St. John River, across this stream and through the parish of Portland through and beyond Torryburn, while a second but narrower belt skirts the southern edge of the Laurentian area, appearing on either side of Musquash Harbor, crossing the peninsula of Pisarinco and reappearing near the suspension bridge of the St. John River. At Lily Lake, near St. John, the limestones of this latter belt pass beneath

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a narrow band of schistose petrosiliceous strata of the Coastal (Huronian) group (Division 4), which intervene between them and the basal beds of the Primordial.

In the eastern portion of the metamorphic area other rocks, presumably representing the upper portion of Division 2, and embracing limestones and dolomites of Laurentian aspect, are met with in eastern Kings and Albert, forming two anticlinal ridges, which are separated by the rocks of Division 4.

The rocks of Division 3 are most extensively exposed along the Division 3 county line of St. John and Kings. Their eastern limit is in the northern part of Mechanic settlement in Kings county, where the petrosiliceous and slaty portions are found apparently resting upon strata which bear some resemblance to those of Division 2, from which, however, they are in places separated by intrusions of diorite and possibly by faults. West of Donegal settlement the rocks of this group increase rapidly in breadth, and on the Shepody road, where they are well exposed between Hammond River and Londonderry post office, they have a superficial breadth of about seven miles. Over portions of this area, however, as in Long and Filamaro settlements, they are in part covered and concealed by the schistose and amygdaloidal beds of Division 4, which also flank them upon their northern and southern sides. At Handford Brook and thence westward to St. John, the Huronian rocks are separated into two belts by the Primordial Silurian (Cambrian), and they are also covered over, on the east side of St. John Harbour, by the Mispick Devonian. With the possible exception of Mechanic settlement, no instances of direct superposition of the rocks of Division 3 on those of Divisions 2 and 1 have been observed. As, however, the rocks of that division, being largely made up of volcanic or semi-volcanic material, are extremely variable in thickness and character, but little stress can be placed upon their absence, while the distinct superposition of Division 4 upon Division 3, as well as upon Division 2, leaves no reasonable doubt as to their true succession.

The relations of Division 4, the so-called former Coastal group, to the Division 4 petrosiliceous rocks of Division 3 are well seen along either of the roads running southerly or south-easterly across the county of St. John, but especially along the line of the St. Martins and Upham railway, between Upham and Quaco, or on the Lower Quaco road either side of Bloomsbury Mountain. In passing from the one to the other at these several points, there is often, though not always, a somewhat abrupt change of dip, the higher beds, or those of Division 4, dipping at a much lower angle than the beds upon which they rest, while along the same line of contact it is not uncommon to find masses of coarse breccia conglomerate

ate in which the fragments are largely of petrosilex derived from the inferior group. It is, however, questionable whether the unconformability thus indicated is sufficient to prove the fact of any considerable lapse of time as having occurred between the two, they being very generally found together, and exhibiting many features of close resemblance, more especially as regards the abundance in both of volcanic products. The extreme fineness of many of the rocks of Division 3, together with the prevalence of breccias and the frequent absence of recognizable stratification, in contrast with the schistose character of Division 4 and the abundance in the latter of coarse conglomerates, may be explained upon the supposition that they result from differences in the conditions of deposition.

In addition to the main belts of Coastal rocks (Division 4) above described, areas of more limited extent are at various points met with overlying or occupying low synclines of the Coldbrook group (Division 3), as in the valley of Black River, near Garnett settlement, in Golden Grove and elsewhere.

Division 5.
Kingston group

Division 5 derives its name from its great development in the Kingston peninsula, which is almost entirely composed of the rocks of this group, and whence it may be traced westward to the shores of Beaver Harbour. The age and equivalency of these Kingston rocks, as well as the somewhat similar belt of slate and diorite occupying the Mascarene peninsula and thence extending through the chain of the western isles, have been subjects of much discussion; the uncertainty as to their true position arising in part from the difficulty of obtaining satisfactory stratigraphical data bearing upon the subject, and in part from the close resemblance which many of them bear on the one hand to the rocks of the Huronian system, and on the other to those of the Silurian. The difficulty was further increased by the occurrence at a variety of points, as well in Washington county, Me., as in this province, of fossils of Silurian aspect in rocks apparently forming a portion of the Kingston series, and under circumstances which seemed to point to this as their proper horizon. Thus, along the south side of the Long Reach, fossil corals and other forms were found by Mr. Matthew in 1878 to occur in a band of felspathic ash rocks, singularly like some of those in the Huronian of St. John county, and which had an apparent dip which would seem to constitute them the lowest member of the rocks of the Kingston peninsula. Subsequent investigations, however, served to show that these Silurian beds abut unconformably against the crystalline rocks of the peninsula, and are of much more recent age. In consequence of this discovery the typical and crystalline rocks of the Kingston series, compared in earlier reports with the Upper Silurian, were in 1878 referred back to their

Fossils.

original position. A similar peninsula was noticed but as to the important points and the Kingston rocks of the peninsula were noticed and

Compare Kingston rocks. Between the two there is an occurrence may represent Laurentian Reach, near Harbour.

St. John River east, being These rest on Laurentian exposed breccias exposed on settlement, northerly of showing the peninsula is changes to which runs Finlay settlement been traced, and present sections are the road leads both these rocksous section to the extremity possibly indicated described in

The eastern part of the peninsula terminates at the mouth of the river it becomes covered by the glacial deposits

original position, and are here represented as pre-Cambrian (Huronian). A similar plan has been adopted in the case of the rocks of the Letite peninsula with their extension through Deer and Campo Bello Islands; but as to these the authors feel less confident, they presenting important points of difference in comparison both with the typical Huronian and the Kingston group, while in some of their features they recall the rocks of northern Charlotte and Queens counties, to be presently noticed under the designation of Cambro-Silurian.

Compared with the typical Huronian of St. John county, the true Kingston rocks appear to include both Divisions 3 and 4. (Rep. 1877-78.) Between these and the rocks of Letite peninsula, referred to above, there is in Charlotte county an axis of older rocks, which, from the occurrence of limestones in Frye's Island, and other lithological features, may represent a second parallel belt of rocks equivalent to the so-called Laurentian of St. John. It may be traced from the head of the Long Reach, near the mouth of Jones' Creek, south-west to the L'Etang Harbour. The extension of the Kingston group (Division 5) west of the St. John River presents precisely the same character as is seen on the east, being composed principally of felsite, felsite schist and diorite. These rest upon the northern side of the syenite and gneiss axis of the Laurentian (report of 1870-71), with a dip of N. W. $< 70^\circ$, and show an exposed breadth along the river of about three miles. The rocks are well exposed on two roads running west from the river road to the Finlay settlement, about two and a half miles from the river. On the more northerly of these two roads a reverse dip $< S. 55^\circ E. < 70^\circ$ is seen, showing that the synclinal structure of the centre of the Kingston peninsula is maintained westward; a little further west the dip again changes to the north-west, indicating the extension of the anticlinal which runs along the south shore of the Long Reach. Between Finlay settlement and Lepreau River the rocks of this group have not been traced, but on that river they again appear directly on the strike and present precisely similar characters. West of the Lepreau, good sections are presented along the St. Andrews post-road, as well as on the road leading down to the mouth of New River, the general dip on both these roads being $S. 30^\circ E. < 40^\circ-70^\circ$. They extend in a continuous section to Barnaby's Head on the west side of Lepreau Harbour, near the extremity of which is a reverse dip to N. $60^\circ W. < 50^\circ$, which may possibly indicate the southern line of contact with the syenitic gneiss described in former reports as extending west from St. John to Lepreau.

The eastern extension of the main ridge of Kingston rocks terminates at the road leading from Norton station to Belleisle corner, when it becomes covered over by Lower Carboniferous sediments, which occupy the greater part of the Kennebecasis valley to the eastward;

Kingston group
west of St. John
River.

Eastern
extension of
Kingston Rocks.

but at two points at least the older rocks reappear and form the ridges known as Jordan's and White's mountains in eastern Kings county, and again at Indian Mountain, in Westmoreland, where the characteristic red felsites of the group appear.

Pre-Cambrian
rocks on line
between Kings
and Queens.

Another belt of pre-Cambrian rocks is found extending along the county line between Kings and Queens. These are of the usual type of felsite, petrosilex, schist and felspathic ash rock with conglomerate. West of the St. John River they are seen in the prominences known as Blue Mountain and Broke-Neck, as well as several other hills in the vicinity of Jones' Creek. These hills are principally composed of highly crystalline felsite, the depressions being filled with fossiliferous Silurian rocks resting unconformably upon them. On the eastern side of the river, Huronian rocks, which are probably the continuation of those on the north side of the Long Reach, extend up the south shore of Belleisle Bay and as far east as Snyder Mountain, beyond which they become obscured under the great mantle of Carboniferous rocks. In the vicinity of the East Scotch settlement, and on the road to the English settlement, these pre-Cambrian rocks have a breadth of three to four miles, and comprise felspathic, micaceous and talcose schist, petrosilex and other felspathic rocks, with felsite ash conglomerate. Small areas occur on Carmichael's, Ryan's, and Lunn's brooks, where the felsite and schist are well exposed, but the areas are limited by the Lower Carboniferous and Millstone Grit sediments. In Queens county, in the parish of Wickham, felspathic and petrosiliceous rocks with black slate occur, which form ridges, surrounded by the Cambro-Silurian beds of this vicinity.

The general strike of all these ridges of pre-Cambrian rocks is very nearly N. 65° E. Their physical characters and detailed structure have been given in former reports. (See reports of 1870-71, 1875-6, 1876-77, 1877-78.)

II. CAMBRIAN, OR PRIMORDIAL SILURIAN.

General
distribution.

The rocks of this age are developed principally to the east of the St. John River. They occupy basins or trough-like depressions among the older hills of pre-Cambrian rocks. The early history of these rocks has been given in the General Report, 1870-71, under the heading of "St. John, or Acadian Group." Since then their distribution has been more carefully studied, principally by Prof. Bailey in 1877. They were found to occur in six parallel bands, occupying basins, sometimes of considerable but at others of very limited area. The most northerly belt is seen on the St. John & Maine railroad, just south of Nerepis station. Here the rocks consist principally of the purple sandstone

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and conglomerate which constitute the basal beds of this formation. The second area, which is also one of the largest in the southern part of the province, is well developed along the north shore of the Long Reach. It is seen about the mouth of the Nerepis and along the line of railroad at that point, and can be traced eastward along the shore as far as Caton's Island, when it is covered by the waters of the River St. John, but reappears again on the south side at the end of Gorham's Bluff. A further extension of these beds may possibly occur about Tenant's Cove, on the east side of the river. This suggestion was mentioned in the report of 1870-71, when the lithological resemblance of the rocks surrounding the cove to those of the St. John group was noted, but as no fossils have yet been found in this band it has been deemed best to include it in the Cambro-Silurian. Characteristic fossils of this group are found at several points along the Reach, notably at Caton's Island and near Westfield church, in a small brook. Some of these have been determined by the late Mr. Billings, and descriptions have been published in former reports. Going south and crossing the Kingston peninsula, we find the third and fourth bands on the north and south shores of Kennebecasis Bay. The more northerly of these occurs in small wedge-shaped basins on the eastern end of Kennebecasis Island, Milkish Head and Long Island, overlaid by Lower Carboniferous sediments and resting upon syenites of supposed Laurentian age. At the south side of the bay these rocks are found at Sand Point and on the shore west of Torryburn station. They here dip towards the crystalline limestones, and their contact is probably marked by a fault. Crossing the ridge of syenitic gneiss of the Laurentian, we come to the fifth and most important area. This belt extends from the town of Carleton, west of the St. John River, eastward to and beyond Handford Brook, a distance of over thirty miles, and with a surface breadth, in places, of from three to four miles in its widest portion. It is seen to rest upon the old ridges of the Coldbrook division of the Huronian. Fine sections are afforded at several points, especially at Handford Brook, in the eastern area, which have been given by Prof. Bailey. (See report for 1877-78, pp. 18 and 31.) Characteristic fossils of this group may be collected at several places, notably at Handford Brook, Porter's Stream, Ratcliffe's Millstream, and in and around St. John city.

The sixth and most southerly band of this group is found south of Loch Lomond, between the Black River and Quaco roads. It consists of the usual fossiliferous black slates, and has a breadth of about 150 feet only. Its extension eastward through the Willow Grove settlement is seen overlying the Coastal rocks of Division 4.

Besides these well recognized belts of Primordial or Cambrian rocks, Rocks of uncertain age.

Distribution of the troughs.

others whose age is not so certainly known are found; one of these, already mentioned as occurring about Tenant's Cove, has been described. Stratigraphically, it is apparently superimposed upon the pre-Cambrian belt, which extends along the north side of Belleisle Bay, and it is again seen in the eastern part of the Scotch settlement, occupying a basin in the old pre-Cambrian rocks of that vicinity. The slates and shales are dark, and often ochreous, but no fossils have yet been discovered. Further north in Wickham, about one mile south of Golding's Landing, black slates, which have been supposed to belong to this age, are seen. They apparently, in so far as examined, contain no fossils, but occur on the southern side of the pre-Cambrian ridge which extends eastward along the county line.

Black slates, which apparently underlie the Upper Silurian of Oak Bay, in Charlotte county, are also found near the head of the bay, on the road from St. Stephen to St. Andrews, but, as in the rest of these undetermined cases, they have all been included in the general colour which represents the Cambro-Silurian.

III. CAMBRO-SILURIAN.

Dark argillites. The rocks included under this head comprise the dark argillite group which is largely developed in western and northern Charlotte county, as well as in southern Queens, west of the River St. John; also a large body of what was in 1870-71 described under the head of Laurentian, and which was then considered an upper series or the equivalent of the Montalban group of Dr. Hunt, and which occupies the south-western area of Charlotte, in the parishes of St. Stephen and St. David. The greater part of the latter group is highly metamorphic, and consists of gneiss, quartzite, mica schist, hornblende, and actinolite schist, with some argillite. It presents, in many respects, a strong resemblance to the pre-Cambrian of other portions of the province. This group is overlaid, near Oak Bay, by black slates, which have been compared to the St. John group, and which, in turn, underlie the fossiliferous Silurian about the head of the bay. The slaty or dark argillite portion occupies principally the northern part of the area and eastward, crossing into Queens county, where it may be traced to the St. John River, at Hampstead, and across through the parish of Wickham. Fossils have not been found in this group, and great uncertainty exists as to its exact horizon, some portions resembling closely the Silurian, and even seeming to shade off into the overlying supposed Devonian on its northern flank. As a group, however, it may be said to be intermediate between the pre-Cambrian and the fossiliferous Silurian.

No fossils.

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The rocks been recogn areas in Wickson, but as lithological c beds, which now been as that limited locality, but beds that are any rocks of West of the Queens, King is that exten the northern until it is t around the e shallow basin they surround and Broke-Ne can be fixed w

East of the St. John River, in Kings county, we have included in this group a variety of beds whose relations are not yet clearly made out. Among these, in addition to the beds described on page 6 D under the head of Cambrian, are rocks, between Tenant's and Jones' Coves, a portion of which present marked Huronian characters, but which are so intimately associated with other slaty rocks that their separation is almost impossible. These rocks are described in the report of 1870-71, page 70. Associated beds of bright silvery slate, black carbonaceous slate, chloritic and petrosiliceous rocks are also seen, but the country, in places, is so wooded, and the exposures so few from this cause and from the covering of drift, that their relations are doubtful. For the present, therefore, it has been deemed advisable to include all these various rocks whose stratigraphical relations are uncertain in our general group of Cambro-Silurian. In our examinations of this region fossils, of undeterminable forms, were discovered, only at one point, on the back road near where it is crossed by the Pascobac, about three miles north-west of Callina corner. The beds here appear to occupy a narrow trough between ridges of pre-Cambrian rocks.

Beds of uncertain age.

IV. SILURIAN. (Upper Silurian of former reports.)

The rocks belonging to this formation have not, with one exception, been recognised with certainty east of the St. John River. Certain areas in Wickham were formerly provisionally assigned to this horizon, but as no fossils have ever been found among them, and their lithological characters differ markedly from those of the fossiliferous beds, which are so largely developed west of this river, they have now been assigned to the Cambro-Silurian formation. It is possible that limited areas or patches may exist among the older rocks in that locality, but owing to the extensive covering of Lower Carboniferous beds that are superimposed upon the Cambro-Silurian and pre-Cambrian, any rocks of this age that may have been deposited have been concealed. West of the St. John River, however, several Silurian areas occur in Queens, Kings and Charlotte counties. Of these, the most prominent is that extending west from the Mistake, on the St. John River, along the northern flank of the pre-Cambrian ridge north of the Long Reach, until it is terminated by the granites. These Silurian beds sweep around the eastern end of the granitic axis, and are seen occupying shallow basins in the vicinity of Jones' Creek, in Queens county, where they surround the bosses of Huronian felsite known as Blue Mountain and Broke-Neck, as well as others further west. Their northern limit can be fixed with considerable accuracy. On the St. John River, at the

Scarcely represented east of St. John River.

Areas west of St. John River.

Mistake, the beds are seen to change their course and to extend down the Reach, where a narrow fringe is seen, holding fossils of this age, along the eastern shore from the mouth of Bostwick's Brook to Carter's Point. They are here seen abutting against the older rocks of the Kingston peninsula, and their unconformability is well marked. They probably rest upon the Cambrian beds which are developed along the western shore of the Reach, and which, doubtless, form a synclinal occupying the eastern side of the river, the anticlinal being well marked on Caton's Island, on which the Silurian beds rest unconformably. The discovery of the Silurian age of these beds is due to Mr. Matthew, who first found fossils in them at Whelpley's Point, in Elmsdale. The character of the rocks, however, differ from the usual slaty aspect of the Silurian, in being more of the nature of ash beds, resembling in many respects some of the rocks of pre-Cambrian age in the coast range.

Fossiliferous
beds.

The characters of the Silurian rocks west of the St. John have been already described in the report of 1870-71. They contain abundance of fossils throughout their whole extent from the mouth of Jones' Creek, along the back road and the line of the St. John & Maine (formerly Western Extension) railway. These beds are seen to change their character as they approach the granite, and to become more siliceous and flinty, but the fossils can be easily distinguished even in their altered portions. North of the granite the extension of these beds has been determined in so far as the wooded character of the country would permit. The stratigraphical relations of the fossiliferous Silurian to the Siluro-Cambrian, including the dark argillites, indicate that the former belongs to a higher horizon, and it probably lies in basins unconformably upon the latter.

Silurian
of Charlotte.

In Charlotte county the principal areas of Silurian are about the head of Oak Bay, around the eastern and northern shores of Passamaquoddy Bay, and about the islands and peninsula of L'Etang Harbour. The Mascarene series, described in the report of 1870-71 as of uncertain age, has been assigned to this formation on the evidence of fossils found at Pembroke, in the State of Maine. (See report of 1874-75.) In former reports (1875-77) a portion of the Kingston group was assigned to this horizon, but subsequent examinations have referred it back to the Huronian, both on lithological and stratigraphical evidence. In so far as our examinations have extended in this province, the metamorphic rocks are generally found to belong to horizons older than Silurian, and when metamorphism has occurred among beds of Silurian age its cause is generally local and the areas limited. Moreover, the Silurian beds, wherever met with in the southern and northern portions of the Province, are plainly distinguished by abundance of

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V. DEVONIAN.

The areas of Devonian occurring in southern New Brunswick may be stated as follows:—

1. A large basin, or double synclinal, east of St. John Harbour, occupying the valley of the Mispec, with a southern area extending north-easterly across the Black River, near the forks of the East Branch. Areas of Devonian.
2. Isolated outcrops on Coal Creek and on Canaan River and North Fork, presumably of this age, but lacking evidence of fossils.
3. Small areas about St. John and Carleton, with possibly Partridge Island.
4. A small area about the eastern extremity of Spruce Lake, on the St. Andrews railroad.
5. A belt stretching west from Musquash Harbour to Lepreau Harbour, in which is contained the so-called anthracite mine of Belas Basin, with a smaller detached area along the shore from By Chance Harbour to Dipper Harbour.
5. A large area in the northern part of Charlotte county, embracing the former pale argillite series and extending into Queens county. Typical area.

Of these the first, or area east of St. John Harbour, may be styled the typical Devonian of the province. Its division and characters are stated in full in the report of 1870-71, the estimated thickness of the four divisions being given at 7,500 feet. This formation has a particularly rich fauna and flora, whose details have been very carefully worked up, principally by the late Professor C. F. Hartt. The fossils especially abound in the *Dadoxylon* sandstone and *Cordaite* slate, the former containing, in addition to the plant remains, several crustaceans and wings of insects. Many of the plant stems are graphitized, and at Belas Basin, in Lepreau Harbour, a bed of graphitic anthracite has been opened.

West of the St. John Harbour, the principal surveys made on this formation, since the report of 1870-71, include the area extending from Musquash Harbour to Lepreau. Coast west of Musquash Harbour. On the coast west of Musquash, the rocks of this age are first observed about midway between Little Musquash and By Chance Harbour, where purple and grey sandstones and slates are seen skirting the eastern side of the harbour, dipping S. 80° E. < 15°-20°, and resting unconformably upon the crystalline limestones, syenite and felsite of the pre-Cambrian. From this point they occupy the shore as far as the west side of Little Dipper Harbour, being well developed about Chance Harbour. On the west side of

Little Dipper Harbour they are seen to dip off from the northern flank of hard crystalline greenish and purple porphyritic felsites of pre-Cambrian age, which occupy the extremity of the western side of the harbour, and which extend thence along the shore to the northern side of Dipper Harbour, where the Devonian rocks again touch the shore. These Devonian rocks are seen to occupy a shallow synclinal, their northern edge resting upon the pre-Cambrian (Laurentian) ridge that extends from St. John to Lepreau, and dipping southward at a low angle. The surface breadth of this belt is about one mile. This southern or coast area terminates just at the telegraph road to Point Lepreau.

The northern or larger area has a maximum breadth of two and a half miles. It rests unconformably upon the Laurentian gneisses both on the north and south. At least two anticlinals, with several faults, are observable. Both the Dadoxylon sandstone and Cordaite slates are represented in this belt, the rocks being principally dark purple and grey sandstone and conglomerate, with bands of dark blackish grey slate and thin bands of purple, red and bluish grey limestone. The grey beds, which are often of a glassy quartzose character, form the base of the series in this direction, and represent the Dadoxylon sandstone of the Mispec section.

Continuation
toward Lepreau

On the Telegraph road, from the St. Andrews road to Dipper Harbour, they are seen to form a sharp synclinal with a dip of S. 10° E. 70° along the northern margin about Musquash, which is reversed to N. 20° W. < 70° on the road to Dipper Harbour. These are overlaid by the purple sandstones and conglomerates, with shales of the Cordaite division, the contact being probably marked by a fault. These purple beds also form a synclinal, with their southern margin resting upon the syenitic and porphyritic felsites of the ridge north of Chance Harbour, over which they fold and again reappear on the slope of the hill overlooking the harbour, the crest of the ridge having been removed by denudation. This belt may be traced westward without interruption to the waters of Lepreau Harbour, where it has an exposed breadth of about one mile, extending from the south side of Belas Basin to the north side of Boyle's Beach, on the north side of Ragged Head. At this place, as well as on the Little Lepreau, the broken character and faulted structure of these beds is well shewn. At the point where the road from Lepreau village to Hanson's coal mine crosses the Little Lepreau River, the grey beds (quartzites) which form the base of the formation in this area are seen to dip S. 15° E. < 90°, resting against the Laurentian syenitic gneiss. Going south, the dip changes to S. 10° E. < 75°, and at Little Lepreau Basin the contact of the grey and purple beds is observed with the same dip—S. 10° E. < 75°

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Crossing the narrow peninsula between Little Lepreau and Belas Basin, in which the coal mine is situated, we find the grey beds again in contact with the purple, but this time apparently overlying them. This would indicate a slight overturn of the beds at this point, the dip being nearly vertical, or S. 10° E. $< 80^{\circ}$, by which the lower grey beds are brought into an apparently higher position. Crossing the bridge over the Belas Basin, the purple beds are again seen, in their regular position above the grey beds of the Dadoxylon division, and apparently dip towards the syenites and limestones of the pre-Cambrian axis of Mace's Bay. At the south side of Boyle's Beach the grey beds of the Devonian are seen to be unconformably overlaid by the red conglomerates and sandstones of the Perry group at the base of the Lower Carboniferous, the dip of the former being to S. 10° W. $< 40^{\circ}$, and of the overlying beds N. 70° W. $< 30^{\circ}$. Just at the water line, at the contact of the grey and purple beds on the north side of Belas Basin, the irregular deposit of carbonaceous shale and graphitic anthracite is found, upon which work has been carried on for the last four years. During this time several shafts have been sunk, the deepest of which in 1878 had reached 140 feet. The thickness of the seam is stated by the miners to be in places twenty feet, but by far the greater portion of this is carbonaceous shale of no value whatever. The western extension of this seam can be seen in a small cove just beyond the entrance to the basin and just south of McPherson's house, where a fault is observed between the grey and purple beds, and a seam of black carbonaceous shale six inches thick is exposed. Another exposure occurs on the south side of the basin, and about one-fourth of a mile inside the head of the sea-wall, where a thin seam of black carbonaceous clay or shale of no value is seen at the contact of the porphyritic felsites and the red conglomerates of Point Lepreau. At the mine, two of the shafts were sunk on the main seam; one of these followed the inclination of the beds. In the first 110 feet the inclination was to the north at an angle of eighty degrees, when it bent round to the southward and continued at the same angle. This would tend to confirm the supposed overturn which was noticed in these beds at the surface. The harder portions of this seam, or the coal proper, burn readily with a good draught until the carbonaceous matter is consumed, leaving a large quantity of reddish ash. Analyses of samples from its outcrop, by Dr. Harrington, gave 36.88 per cent. of ash, and the quality in going down does not appear to improve. From its position in the Devonian, in connection with its graphitic character and irregular occurrence, it is exceedingly doubtful if coal of sufficient purity for marketable purposes will be obtained. This locality was first noted by Dr. Gesner in his reports to the New

Rocks in
vicinity of
Lepreau mine.

Character of
coal seam.

Lepreau mine.

Brunswick government, and attention was drawn by him to the occurrence of the coal in what he then considered to be rocks of the age of the New Red Sandstone. From the reefs at Ragged Head beautifully preserved specimens of Devonian plants are obtained, many of which are graphitized. Some of these have been described. (See report of 1870-71.)

Similar coal in
Massachusetts
and Rhode
Island.

A similar case of the occurrence of anthracite in rocks of presumed Devonian age may be mentioned as existing in the states of Massachusetts and Rhode Island, and is described in the report of Dr. Edward Hitchcock on the Geology of Massachusetts for 1841. In this he describes the occurrence of coal of precisely similar character to that of Lepreau, glazed with plumbago, and occasionally converted into that mineral; very irregular in its distribution, and in rocks lithologically resembling those in which the Lepreau mine is situated. These rocks which probably correspond with the grey quartzites of the New Brunswick Devonian, he characterizes as greywacke and greywacke slates, while the other members of the Devonian are represented by soft black, brown and grey shales, slates and sandstones. Although reports on this coal at the time of its discovery were quite favourable, it does not seem to have been ever worked with any degree of success, and its large percentage of ash, as with the Lepreau anthracite, was probably fatal to its successful development.

Devonian of
northern part
of Charlotte.

The largest area of rocks of this age is that occurring in the northern part of Charlotte county, and extending eastward into Queens county. These rocks have been described in the report of 1870-71, and are also briefly mentioned in the report of 1876-77. They comprise the former so-called pale argillite group. They are superimposed upon Cambro-Silurian rocks, and extend from the St. Croix River, near Sprague's Falls, to the Charlotte county line, and thence into York. At the line of contact the dips are nearly vertical, but there is in places an apparent conformability between the dark argillite portion of the Cambro-Silurian and the series under discussion. It is probable, however, that faults occur at the line of contact, as the beds of fossiliferous Silurian so well developed about Oak Bay, on the south side of the Cambro-Silurian belt, are entirely wanting along the northern margin. The Devonian age of these rocks has been based by Mr. Matthew upon the occurrence of remains of *Lepidodendron* found in Cox's Brook, a small branch of the Magaguadavic River, as well as from certain graphitic films, supposed to be the impression of fern leaves, found in the eastern extension of these beds into Queens county. They also possess many points of resemblance, lithologically, to the typical Devonian of Mispec, and hence they have been provisionally assigned to this horizon. Their exact relations have not as yet been determined, the unfavourable

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nature of the country rendering their examination, except at distant intervals, very difficult, and they may be therefore stated as resting unconformably upon rocks presumably of Cambro-Silurian age, and underlying the Lower Carboniferous sediments which surround the central Carboniferous basin.

VI. LOWER CARBONIFEROUS.

The general distribution of the Lower Carboniferous of Queens and Sunbury counties has been stated in the report of 1872-73. The formation, as seen in these counties, differs largely in the character of its sediments from its recognised development in the southern and eastern areas, in the presence of large areas of trappean and other volcanic rocks, soft felspathic ashes or claystone, as well as harder felspathic beds. These are found not only along the southern border of the central Carboniferous basin, but are seen protruding through the grey sandy beds around the head of Grand Lake, forming hills and ridges often of considerable elevation, which furnish conspicuous landmarks in the otherwise generally level surface. In the counties of Queens and Sunbury the rocks of this age form generally a margin of no great breadth around the southern edge of the coal basin, but in Kings they spread out and occupy the greater part of the valley of the Kennebecasis Bay and River, having an exposed breadth in some places of twenty miles. East of Penobscis station, on the Intercolonial railway, they are covered by the grey beds of the Millstone Grit, but to the westward they extend beyond the St. John River. The basin-shaped character of this formation is well-marked; the rocks lying unconformably upon the pre-Cambrian, Cambrian and Devonian beds. Areas of less extent exist among the pre-Cambrian hills of Kings and Albert, and in the latter county they sweep around the eastern extremity of the pre-Cambrian ridge at the Albert Mine, and thence extend down the valley of Demoiselle Creek and westward along the shore to the mouth of Point Wolf River. Smaller patches are likewise found at the mouth of Goose Creek and Martin's Head, in St. John county, and at the latter of these places there is a deposit of fibrous gypsum of considerable extent. In Charlotte county this formation is but sparingly developed. The deposits of Lepreau and St. Andrews, with outliers about the shores of Passamaquoddy Bay, are the principal. These are interesting as containing in their lower portions fossils of Devonian type, while the beds themselves are unconformably superimposed upon the true Devonian, and otherwise possess the characters of the Lower Carboniferous rocks, the several members of which, as developed in southern New Brunswick, may be described in descending order as follows:

Subdivision.

1. Red and grey conglomerates, with thin reddish shales and beds of gypsum, and flaggy, often bituminous, limestone.

2. Red and grey calcareous and argillaceous beds in frequent alternations, with thin conglomerates, and heavy beds of rubbly brownish-red and fine-grained shales towards the top.

3. Grey and red conglomerates of varied composition, with beds of greyish and brownish oil-bearing micaceous and bituminous sandstones.

4. Calcareous and bituminous shales, grey and dark brown, including the so-called Albert shales, with an underlying set of greenish-grey conglomerates. This series is overlaid unconformably by reddish or brownish sandy shales, which form the basal beds of No. 3.

Horizon of
Albert shales.

Stratigraphically, the beds of Albert shales, or Division 4, as developed in Albert and Westmorland counties, may belong to a lower horizon than the Carboniferous, and may constitute an upper portion of the Devonian, but the prevailing fossils, both fishes and plants, seem to indicate a Lower Carboniferous age. Bituminous shales, however, are found to occur interstratified with undoubted Lower Carboniferous sandstones and conglomerates further west in Kings county, on the South Branch of the Kennebecasis, as well as on the South-west Branch of Trout Creek. On the latter stream the felsites of the mountain are overlaid by red conglomerates and limestones, dipping northward at an angle of 20° . These, at the road crossing to Dutch Valley, contain an interstratified band of highly bituminous shales of the same type as those of the Albert Mines and Elgin, with numerous scattered remains of the genus *Palaeoniscus*. They are again brought up by a fold about one mile down the South-west Branch, and are associated with the ordinary red sandstones and conglomerates that mark the rocks of this age. Further down on Ward's Creek, about one and a quarter miles south of Sussex station, these bituminous shales are again brought to the surface by another undulation. Further west, about two miles below Norton station, the extension of this anticlinal is seen on the post-road, where it crosses the Moosehorn Brook. North of the railroad the bituminous shales have not been met with, but on the road running west from Butternut Ridge to Queensville, on Price's Brook, about five miles west of the Ridge Corner, bituminous limestones similar to those of Hillsboro' and the Albert Mines are seen, and would lead to the inference that the shales extend in a broad sheet across the intervening country, brought up at intervals by the series of gentle undulations which have affected the rocks of the central basin. In addition to the localities already described, as well as those mentioned in the report of 1876-77, in Albert and Westmorland counties, shales of this character are met with on the South Branch of the Kennebecasis, about six miles

from Penobsquis station. They are here reported to contain a vein of albertite. Another deposit in Mechanic settlement is very interesting, and occurs on what is known as the Haley farm. Here Lower Carboniferous sediments appear in a depression among the green chloritic slates of the pre-Cambrian series. These slates dip N. 65° W. $< 50^{\circ}$, and disclose a narrow trough-like basin ninety paces in width, filled in with greenish-grey conglomerates, the pebbles of the old slates and other metamorphic rocks being cemented together with a fine dark paste, full of particles of albertite, and intersected by very fine seams of the same. An irregular vein of albertite occurs in a fissure among these conglomerates, no shales being visible, but the deposit is very limited, and may be styled a local pocket rather than a regular vein. A crack in the older slates, however, which underlie the bituminous beds, has become filled with albertite, which at first sight almost looks as if it had been injected from below along a line of fault, but it has probably been filled by infiltration; and on Martin's farm, on the north side of the road, the granitoid rocks which there underlie the Lower Carboniferous, disclose the same peculiarity, being impregnated to the depth of an eighth of an inch with bitumen, while the numerous joints which intersect the rock are also filled with particles of albertite. As the bituminous matter has been shown, in former reports, to belong to the Lower Carboniferous strata, we must, of necessity, infer that the albertite or bituminous matter in the granitoid and slaty rocks has been derived from the overlying bituminous shales and conglomerates. Economically speaking, this deposit is of no value.

Albertite in
older rocks.

In the report of 1876-77, the distribution of the Albert shales in western Albert was given, and their similarity to the albertite-producing beds of the Albert Mines led to the formation of a company in 1876 for the purpose of proving this area by boring with the diamond drill. A number of holes were put down about Elgin and in Mapleton, but no traces of albertite were found. Although the character of the beds is identical with those of the Albert Mines, both in lithological aspect and in the presence of bitumen, yet the physical features of the two areas are very different. No strongly marked anticlinals occur in the beds in the western part of the county, like that seen at the Albert Mines, nor does the general character of the formation tend to warrant the expenditure of any considerable sum of money in underground exploration. From our examinations of the whole area occupied by these shales, we can only say that we consider the occurrence of albertite at the Albert Mines due almost entirely to peculiar local conditions that, so far as we have seen, do not exist elsewhere to the same extent. The explorations carried on at Beliveau and Taylorville during the past four years tend to confirm this opinion.

Exploration
for albertite.

Gypsum and
manganese.

Besides the albertite, this formation contains gypsum and manganese. The distribution and mode of occurrence of the former mineral are given in the report of 1876-77. Of manganese, several deposits exist. Of these, that at Markhamville is, so far as known, the most important. It has long been worked with varying success, and mining on it is still in progress. Its position is near the contact of the Lower Carboniferous conglomerates and limestones with the felsites and slates of the pre-Cambrian ridge. At Quaco Head also a small deposit occurs in rocks of the Lower Carboniferous age, preparations for working which are already being made on quite a large scale. On the east side of Salisbury Bay, in Albert county, there is also a small deposit near the contact of the Lower Carboniferous and Triassic sandstones, and at Hillsdale, about five miles south-west of Elgin corner, large pieces of fine ore are picked up, but the vein has not yet been discovered. Bog manganese also occurs at various points, but no deposits of any particular value have been found.

Disturbances
during Lower
Carboniferous

During the time that the rocks of Lower Carboniferous age were being deposited, violent disturbances occurred. These appear to have been quite local and to have affected principally the rocks in Albert county, where the lower portion of the formation has been extensively folded and faulted, and in places penetrated by dykes of igneous rocks. The upper members, however, occur in nearly horizontal beds. In the central or Kings county basin the rocks of this formation lie in several folds, but do not give evidence of any extensive disturbance. At Quaco, the Lower Carboniferous limestones have been penetrated by dykes of trap of large size, probably of Triassic age, by which the limestones have been thrown into an anticlinal and changed to a highly crystalline rock.

Fossils.

Over many parts of the area covered by the rocks of this formation, fossils peculiar to the time are found. Reference has already been made to the fossil fishes of the genus *Palæoniscus*, which are so plentiful in some portions of the Albert shales. In 1877, among the specimens obtained from this belt, was a new species, which has been described by Principal Dawson under the name of *P. modulus*, and figured in the appendix to the Acadian Geology. Beautiful specimens also occur in some of the nodules from the shales, one of which, in nearly perfect condition, measured 10 inches in length and $3\frac{1}{4}$ inches in breadth, the breadth at the dorsal fin being about equal to that at the shoulder, and diminishing rapidly to the tail. In this specimen the crystalline lens of the eye is preserved in calcite, and shows its structure. This is especially interesting, as being the first instance known of the preservation of the eye of a palæozoic fish.

Among the limestones also, which constitute a considerable portion

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of the formation, especially in its upper part, specimens of *Terebratula suflata* and *T. sacculus*, with other forms, occur. Good localities for these are at Rush Hill, in Wickham, and at Hampstead, on the shore of the St. John River, a short distance below Otnabog Lake. Many of these have been mentioned in the report of 1870-71.

VII. MIDDLE CARBONIFEROUS.

In addition to the remarks on this group in the report of 1870-71, a Subdivisions. special report was published, having reference principally to the Grand Lake coalfield, in 1872-73. The group was then subdivided into Millstone Grit, Middle Carboniferous and Upper Coal Measures, though on no very good grounds, as no distinct line of demarcation between any of the groups can be drawn, and it now seems highly probable, from investigations made since that report, both from the character of the rocks as compared with those of Cape Breton and Nova Scotia, as well as from the Millstone Grit age of many of the fossils from the Grand Lake and elsewhere, that the great bulk of the sediments composing the central Carboniferous basin of the province, as well as those along the southern shore, are of Millstone Grit age, and that the higher members of the formation, if ever deposited, have been since denuded. The general horizontality of the measures would indicate an almost General aspect. entirely undisturbed condition of things since the deposition of the beds in the central area, and would lead one to infer that the Carboniferous rocks of central and eastern New Brunswick, although spreading over a great area, are not only very thin but probably constitute simply the western shallow border of the great Carboniferous basin which underlies the waters of the Gulf of St. Lawrence, and which is bounded by the southern shore of the Gaspé peninsula on the north, and by the high ridge of the Cobequid Hills and the coast ranges of western Cape Breton on the south and east, and upon which the Triassic sandstones of the Island of Prince Edward were subsequently deposited. One might, on this hypothesis, reasonably expect to find more favourable conditions for the occurrence of thicker seams of coal along the eastern coast of the province, where these rocks are more closely associated with the productive measures of Nova Scotia, but this area has never been proved, and only very general surface examinations made at one or two points.

The area, as contained in the counties of Queens and Sunbury, has Explorations for coal. been pretty thoroughly explored. Borings with the diamond drill were carried on at a number of points from 1872 to 1876. The localities tested by this means were Newcastle bridge; Newcastle Creek, on the shore of Grand Lake, about one mile below the steamboat land-

The 'Surface
Seam.'

Quantity of
coal.

ing; Otnabog Bridge; Clones, on the headwaters of the Nerepis River; Three-Tree Creek, and Tracy. The deepest of these borings (600 feet) was made at Three-Tree Creek, while in the Grand Lake area the holes ranged from 170 to 400 feet. In no case did these bore-holes disclose the existence of any lower seam of coal, and it is quite evident that in this area at least this mineral is confined to what is known as the "Surface Seam." The extent of this seam, however, is great. Besides the frequent outcrops along the Newcastle Creek, Salmon River and Salmon Creek, and Coal Creek, which constitute properly the Grand Lake coal area, other exposures, which may be the southern outcrops of the same seam spreading over a larger area, are found. Among these the most westerly is on the North-West Branch of the Oromocto, about one and a half miles above the mouth of the Yoho Stream, where, in the cliff, a seam of four to five inches is disclosed, dipping at a moderate angle to the north-east, and which probably marks its western limit. Further east, a continuation of the same seam is reported on the Mersereau Brook, near its forks with the Oromocto, and again about three miles up in a small branch from the south. It next reappears in Clones, on the head waters of the Nerepis, and has here been proved by the diamond drill, with a thickness of about 10 inches, though reported in one place at 30 inches. East of the St. John River the only outcrop known is near the mouth of Long's Creek, on Starkey's place, where it has a thickness of 10 to 12 inches, but very impure. The Carboniferous beds sweep around the eastern extremity of the pre-Cambrian ridge that extends along the county line of Queens and Kings and fill in a part of the basin or valley of the Kennebecasis; and at one place at least, Dunsinane, between Penobsquis and Anagance, on the Intercolonial, they contain a seam of impure coal of the usual thickness, 18 to 20 inches, and resembling in character many of the outcrops in Queens county. It is probable that all these outcrops belong to the same horizon, and on this supposition this seam, thin as it is, from its spreading over so great an area, would contain an enormous quantity of coal. Assuming the average thickness of the surface seam around the head of Grand Lake at 20 inches, and allowing the available yield of coal for a seam one foot thick to be 1000 tons per acre, we have from the coal basin of Newcastle and Coal Creek, and Salmon River, which may be stated to contain about 100 square miles, a total available yield of coal, due allowance being made for waste, of over 100,000,000 tons for this limited area alone. As this seam is worked, and it is to be supposed profitably, by the present owners of the different mines, at a number of points over the area, it may fairly be presumed that, with economical management and a proper system of working, a large portion of this enormous quantity might be profitably extracted. If we consider also

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that this seam has been found at a great number of points, not only around the entire rim of the Carboniferous basin of the province but also at various places in its interior area, leading to the supposition that it covers an area of several thousands of square miles, the quantity of coal underlying the surface, even if no lower seams should be discovered at any point in the Carboniferous basin, is enormous.

The other areas occupied by rocks of this formation are but small. In southern Albert they are seen to occupy the shore as far west as Herring Cove, with some few breaks which are occupied by rocks of Lower Carboniferous age; this area is the westward extension of the lower part of the celebrated Joggins section, and the beds are in many places tilted up on edge and affected by faults often of considerable extent. About Quaco and to the west as far as Gardener's Creek, rocks of Millstone Grit aspect are seen overlying the red beds of the Lower Carboniferous; and at Tynemouth Creek attempts have been made with a diamond drill to find coal, without meeting with any success. In Charlotte county, the only known area is a small rim of the central basin, which extends across the northern line of the county.

TRIASSIC.

The Triassic of southern New Brunswick is limited in extent, small areas only occurring in St. John county at Red Head, Quaco and Martin's Head, while in Albert county there is a small patch on the east side of Salisbury Bay. In Charlotte county also, the western part of the island of Grand Manan is occupied principally by traps of this age, with a few exposures of red sandstone. The characters of the rocks at these various localities are described in the report of 1870-71, and the only additional information on this subject since then has been derived from the deposit which occurs at Martin's Head. The deposit at this place was discovered in 1877, and is especially interesting as containing lignite. The rocks are soft dull-red sandstones, succeeded by soft greyish-yellow beds and soft brown shales with thin bands of fine brownish conglomerate, which form a synclinal trough, resting upon Lower Carboniferous sediments. The lignite is found principally in the soft brown shales, and has been examined by Principal Dawson. He says:—"The specimens are of coniferous wood, with one large row of disks in the cells, and of the same type with silicified wood from Quaco, as also of the same type as *Dadoxylon Edvardianum* from Prince Edward Island, and similar to fossil wood from the Mesozoic of Virginia." Distribution and character. Lignite.

The Triassic of Quaco is confined to a small margin along the coast at the Head and in the vicinity of the village. At the Head, the soft

red sandstones of this age are seen to abut directly against the conglomerates of the Lower Carboniferous, their contact being indicated by a well-marked fault, which may, in the section through the village, be concealed by drift, or they may lie in shallow unconformable basins of very limited area upon the Lower Carboniferous beds.

SYENITE, DIORITE, FELSITE, &C.

Syenite.

An extended report on these rocks is deferred pending their microscopic examination, but their general distribution and modes of occurrence may be briefly stated. Syenites of different characters and age are found at various points in southern New Brunswick. The largest area is occurs in the county of Charlotte, and has been described in the report (G. S. C.) for 1870-71 under the head of Nerepis Granite. It has been considered as of probably intrusive character, and its age as probably about the close of the Devonian. Scattered or detached bosses also occur at points throughout the western portion of the country. In places, as it approaches the slaty rocks on either side, it is seen to shade off or to merge into a body of felsite or granulite, which, in turn, appears to graduate through petrosiliceous rocks into fossiliferous Silurian or other rocks. Near the contact of the Silurian beds also, the slates have been metamorphosed and crystals of andalusite and staurolite produced.

This belt extends eastward into Queens county. Its prevailing colour is pink or reddish, but at the St. John River, below Hampstead village, where a considerable area of syenite rocks, probably a spur of the large mass to the west, is found, the colour is generally grey, though pink shades also occur. This granite is extensively quarried for building purposes; while in the main area, in the vicinity of St. George, in Charlotte county, extensive quarries are carried on,—a large quantity of the stone being polished. The St. George works have been described in the report of Mr. G. F. Matthew, 1876-77.

Granite.

Throughout the great belt of metamorphic rocks of pre-Cambrian age, syenites, granites and diorites are found. Of the syenites many are evidently of metamorphic origin, the gradual passage from chloritic slates, through schists and felsites, being plainly visible. They are often chloritic or talcose, and have been described in former reports under the head of protogine, but pinkish and grey granites and syenites are also common. These differ from the former in character, and often occur as dykes or veins. In the limestone, or upper portion of the so-called Laurentian, in the vicinity of the Kennebecasis Bay, these syenites are frequently seen cutting the limestones as well

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as the overlying Cambrian slates. No attempt has, however, been made to separate them on the map from the other pre-Cambrian rocks, as they are in many places so intimately associated as to render their distinct delineation on so small a scale an impossibility.

Diorites are found at various points throughout all the formations ^{Diorite.} from the Laurentian to the Triassic inclusive. They are abundant in the pre-Cambrian, especially in Division 5, the former Kingston, a large portion of which is made up of apparently interbedded felsite and fine-grained diorite. In some places the diorites are very coarsely granular and contain much magnetic iron in grains, as at the Scotch settlement, in northern Kings county, and on the Pollet River, south of Elgin corner, in Albert county, typical diorites some of which are almost black from the abundance of hornblende, are found at Mechanic settlement post office and westward, while throughout the pre-Cambrian belt north of Quaco and elsewhere diorite and dioritic ash-rock, with amygdaloid, are very frequent. It has, however, been thought better not to attempt the separation of all the areas of these intrusive rocks on so small a scale, as their exact limits cannot be determined definitely from the unfavourable nature of the country.

In the Lower Carboniferous also, rocks presumably of intrusive ^{Carboniferous and Triassic intrusions.} character are found not only around the southern edge of the central Carboniferous basin, but at various scattered points of the basin itself. They often obtrude through the generally flat beds of the Carboniferous in dome-shaped hills or ridges of dolerite, while felsitic ashes and hard crystalline felsite also occur; the most prominent area of these latter rocks is seen in the northern portions of Charlotte county, whence they extend across into Sunbury. These intrusions were probably not later than the middle of the Lower Carboniferous period.

In the Triassic also, as at Quaco, intrusions of trap similar to that of the North Mountain range of Nova Scotia are seen breaking through the Lower Carboniferous limestones of the Head. The area is, however, but small. A general description of the dioritic rocks of the Lower Carboniferous is given in the report of 1872-73.

ECONOMIC MINERALS.

A full account of the economic minerals of the southern part of the province was given in the report of 1870-71, in so far as they were known at that time. Since then discoveries of more or less importance have been made, but nothing of any special value has been met with.

IRON.

The only new locality where this mineral has been found is on Deer Island, near Lord's Cove. The ore is a nearly pure magnetite of superior quality, and occurs in a vein from two to three feet thick in slates and conglomerates of pre-Cambrian age. It is exposed crossing a narrow promontory, and is only a few feet above tide level.

COPPER.

The principal deposits of copper have been already described in the reports of 1870-71, and nothing has been done of late towards the development of any of the localities therein mentioned.

MANGANESE.

Deposits of this mineral occur at several places in Albert, Kings and Westmorland. They may thus be described:—

Shepody Mountain.—Deposits near the contact of pre-Cambrian chloritic slates and Lower Carboniferous conglomerates, worked in former years quite extensively, but of late nothing has been done.

East Side of Salisbury Bay.—Deposit near the contact of Triassic sandstone and Lower Carboniferous rocks, worked some years ago by the company owning the Markhamville mine, but shortly abandoned.

Hopewell Corner.—Deposit near the contact of Millstone Grit and Lower Carboniferous; about one mile west of Hopewell corner. Soon exhausted.

Hillsdale.—About five miles south-east from Elgin corner. Deposit yet unexplored but fine surface indications.

Petitcodiac. about two miles north-west from Petitcodiac station. Near the contact of Lower Carboniferous limestone and gypsum, vein only about one inch exposed thickness.

Jordan Mountain.—Near the contact of Lower Carboniferous sediments with the pre-Cambrian of the mountain. Good surface indications. Locality not developed.

Markhamville.—Near the contact of Lower Carboniferous limestones and conglomerates with pre-Cambrian. Location long worked. Most extensive deposit as yet known in the Maritime Provinces.

Quaco Head.—Deposit in Lower Carboniferous rocks. Not yet developed, but preparations are now being made for mining at this locality.

Henry's Lake.—Surface indications reported, but deposit not located.

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ARGENTIFEROUS GALENA.

Several localities are mentioned in the report of 1870-71 as affording galena in small quantity. Of these, the only one that has been examined for silver is that on Hammond River, at Wanamake's, which has been found to yield a fair proportion.

A new locality, which was opened in 1878, is on the west side of Musquash Harbor, in Laurentian syenites. Here veins, of eight inches to one foot, of white quartz carry yellow sulphuret of copper and galena. The latter has been assayed by Dr. Harrington, and found to yield a little over \$14 to the ton. (See report of 1877-78, p. 529.) The extreme hardness of the country rock and the smallness of the vein are against the profitable working of this location.

BITUMINOUS COAL.

No new developments have been made in this department since the report of 1872-73. The amount annually raised varies but little, and no attempts have yet been made to carry on the mining in any more systematic manner.

ANTHRACITE.

Within the last four years considerable money has been spent in developing the seam of anthracite which occurs in the Devonian rocks of Belas Basin, Lepreau. Four shafts had been sunk up to 1878, the greatest depth then reached being 140 feet, but the character of the coal did not seem to improve sufficiently to warrant the investment of any further capital. A similar deposit occurs at Clinch's post office, Musquash, in rocks of the same age and character, but this is of no value. The large percentage of ash—36 per cent.—is strongly against the reported good quality of the mineral as a combustible, while its irregular distribution and impure character are also strong obstacles to its successful development. A large part of what has been called coal is nothing but carbonaceous shale, and this constitutes the bulk of the seam, the thickness of the harder or anthracite band being only a few inches.

ALBERTITE.

With the exception of the deposit of this mineral at the Albert Mines, no body of albertite has as yet been found in quantity sufficient for working. Since the report of 1876-77 on this deposit, explorations have been carried on at several places. Borings were made at Elgin corner and Mapleton with the diamond drill in the Albert shale, but

without finding any trace of the mineral sought. The most extensive operations have, however, been carried on by the Beliveau Mining Company. At Beliveau a shaft has been put down to the depth of 200 feet, and tunnels driven north and south across the measures, without finding anything of importance. Borings were then begun at Taylorville, about one mile to the east, since which we have not visited the scene of operations. Reports, however, do not indicate any great measure of success.

GYP SUM.

Gypsum occurs at various points both in Albert, Westmorland and St. John counties; the deposits of Hillsborough have been described in the report of 1876-77, since which new openings have been made at Hopewell Hill, where a splendid deposit of the fibrous variety occurs.

At Fawcett's Brook, about two and a half miles north-west of Petitcodiac station, a large deposit of the fibrous variety is found, which has been locally worked for agricultural purposes for some years. The quality is excellent, and the deposit should be of considerable value.

GRANITE.

The granites of Charlotte county, at many points, afford abundance of excellent stone for building and polishing, but the quarries near St. George, on the Magaguadavic River, are as yet the only localities which are worked. Full descriptions of these, with the polishing works, are given in the report of 1876-77, page 346.

INFUSORIAL EARTH.

Deposits of this substance are found occupying the bottoms of lakes in several places. Among these were specially noted two in eastern Kings county—Pollet River Lake, in Mechanic settlement, and Pleasant Lake, about six miles to the south-west. The deposit in Pollet River Lake is said to be about four feet deep, and the earth is exceedingly fine, of a greyish-white colour when dry, and admirably suited for polishing the finest substances. The lake can be easily drained, or the substance can be removed with a shovel or small dredge.

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